Ordering number: EN 494F

Monolithic Linear IC

SANYO

No.494F

LA3160

2-Channel Preamplifier For Car Stereo

Features

- Two preamplifiers on chip
- Fewer peripheral parts.
- Low noise.
- 8-pin SIP package facilitating easy mounting.

Maximum Ratings at Ta = 25°C

			unit
Maximum Supply Voltage	$V_{CC}max$	18	V
Allowable Power Dissipation	$P_d max$	200	mW
Operating Temperature	Topr	-20 to +75	°C
Storage Temperature	Tstg	-40 to +125	°C

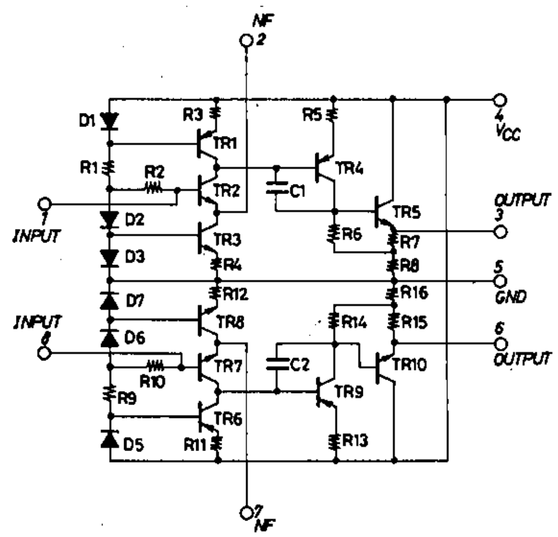
Recommended Operating Conditions at Ta = 25°C

			unit
Supply Voltage	V_{CC}	9	V
Load Resistance	R_L	10k	Ω

Operating Characteristics at Ta = 25°C, V_{CC} = 9V, R_L = 10kΩ, Rg = 600Ω, f = 1kHz, NAB

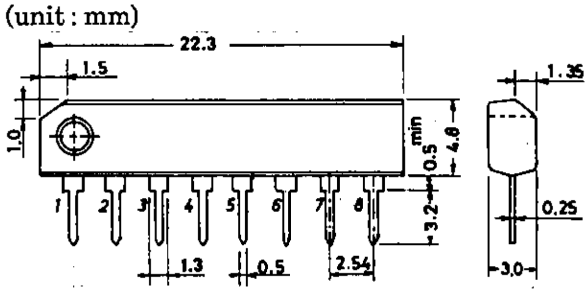
			min	typ	max	unit
Current Dissipation	I_{CC}			4	6	mA
Voltage Gain	VG	Closed loop		35		dB
		Open loop, v_O=0.77V	76	80		dB
Output Voltage	v_O	THD=1%	1.1	1.8		V
Total Harmonic Distortion	THD	v_O=0.5V		0.1	0.3	%
Input Resistance	r_i		70k	100k		Ω
Equivalent Input Noise Voltage	V_{NI}	R_g=2.2kΩ		1.25	2.0	uV
Crosstalk	CT		-50	-65		dB

Equivalent Circuit Block Diagram



Package Dimensions 3016B

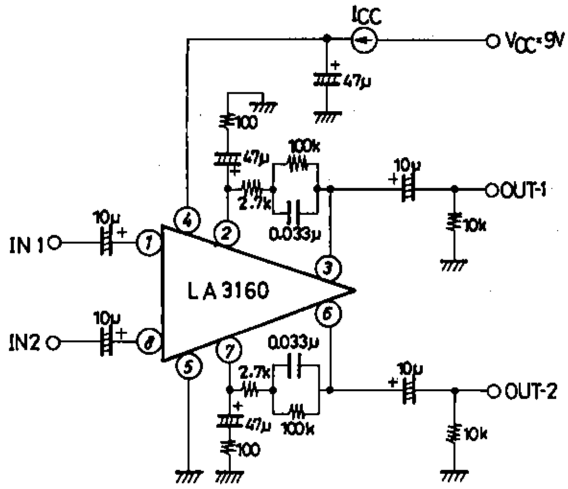
(unit : mm)



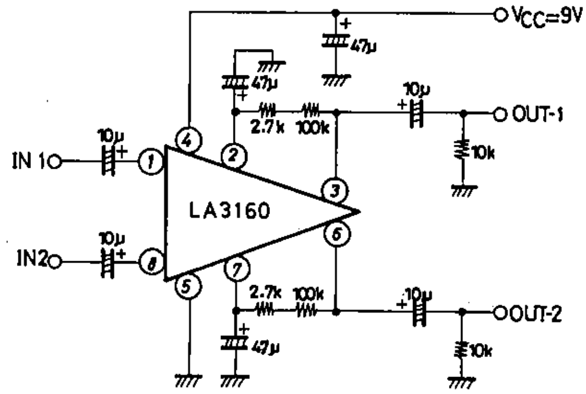
SANYO : SIP8

SANYO Electric Co., Ltd. Semiconductor Business Headquarters
TOKYO OFFICE Tokyo Bldg., 1-10, 1 Chome, Ueno, Taito-ku, TOKYO, 110 JAPAN

Test Circuit 1 : V_O, VG, THD, I_{CC}, r_i

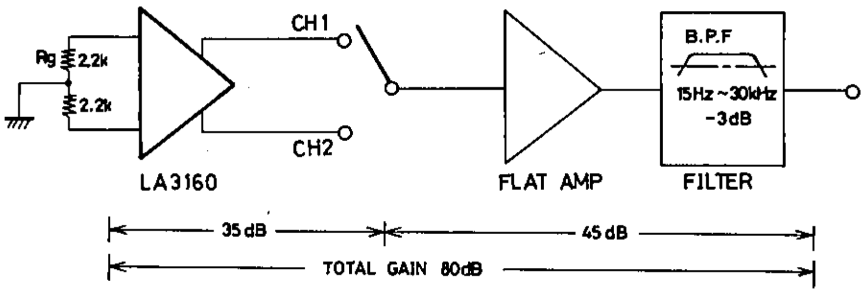


Test Circuit 2 : VG_O

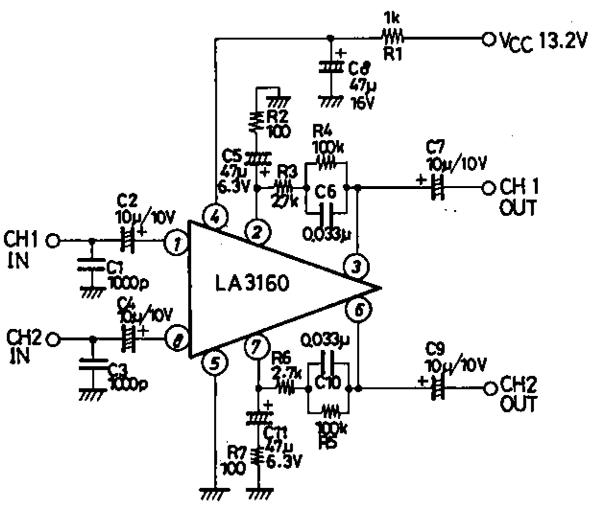


Unit (resistance: Ω, capacitance: F)

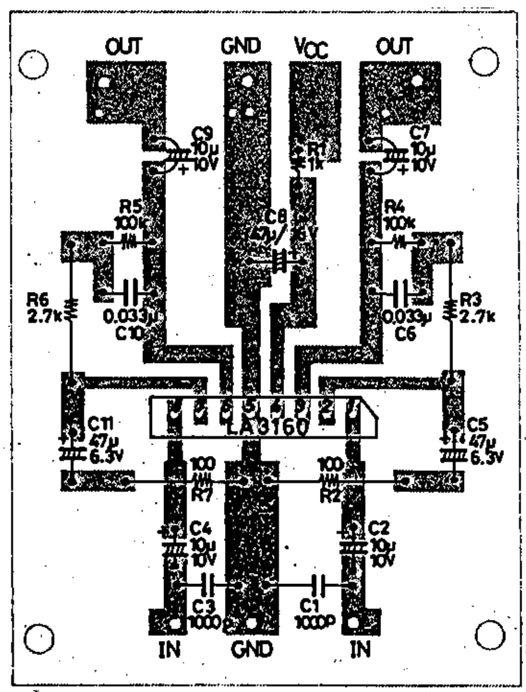
Test Circuit 3 : Noise



Sample Application Circuit 1 : Preamplifier for Car Stereo



Unit (resistance: Ω, capacitance: F)



Sample Printed Circuit Pattern
(Cu-foiled area, $67 \times 50mm^2$)

Function of External Parts

C_2,C_4 are input coupling capacitors. In NAB equalizer amplifier, the gain at low frequencies is high and 1/f noise inside the IC is emphasized as output noise. Therefore, if the reactance of capacitor at low frequencies is increased, the dependence of 1/f noise on the signal source resistance causes the output noise voltage to deteriorate, and the value of reactance must be made small enough as compared with the signal source resistance. C_2,C_4 also influence the operation start time and the adequate value of these capacitors is 10uF. (Since C_2, C_4 of less than 4.7uF make the operation start time longer, use C_2, C_4 of 4.7uF or more.)

C_5,C_{11} are NF capacitors. The lower cut-off frequency depends on the value of these capacitors.
If the lower cut-off frequency is taken as f_L :

$$C5\ (C11) = 1/2\pi \cdot f_L \cdot R2\ (R7)$$

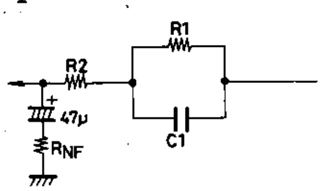
If the value of this capacitor is made larger, the operation start time of amplifier is more delayed. The adequate value of capacitor is 47uF.
The frequency characteristic of the equalizer amplifier depends on C_6 and R_4, R_3 (C_{10} and R_5, R_6).
The time constants to obtain the standard NAB characteristic are as shown below.

Tape speed	9.5 cm/sec	4.75 cm/sec
C6 (R3+R4)	3180 μ sec	1590 μ sec
R3 C6	90 μ sec	120 μ sec

C_8 is a bias capacitor for the power line. C_8 of 47uF is inserted at a point as close to the power supply pin (pin 4) as possible.
C1, C_3 are for preventing radio interference in the strong electric field, interference attributable to engine noise, and blocking oscillation at the time of large amplitude operation. The adequate value of C_1, C_3 is approximately 1000pF.
C_7, C_9 are output coupling capacitors. The adequate value of C_7, C_9 is 10uF.

NAB element and determination of gain

Since the DC feedback is provided by R_1, R_2 of NAB element, which brings about DC output potential at pins 3, 6, it is impossible to change the value of R_1, R_2 of NAB element greatly. Therefore, when determining the gain, change R_{NF} with R_1, R_2, C_1 (NAB element) kept constant.



Unit (resistance: Ω, capacitance: F)

(1) How to obtain R_{NF}
Impedance Z of NAB element is

$$Z = \frac{1}{1/R1 + j\omega C1} + R2 = (R1+R2)\left\{\frac{1 + j\omega C1\{R1R2/(R1+R2)\}}{1 + j\omega C1R1}\right\}$$

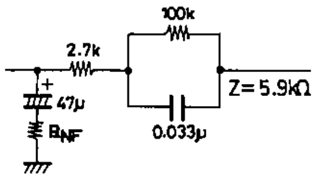
For a general negative feedback amplifier circuit, $A=Ao/(1+Ao\beta)$ applies, and $Z=A \cdot R_{NF}$ is obtained under conditions of $Ao \gg A$, $A \gg 1$ ($\beta=R_{NF}/(R_{NF}+Z)$, Ao=open-loop gain, A=feedback gain).
Therefore, we can use an approximation of $R_{NF}=Z/A$.
A = (VG for 1 kHz) times, (Set R_1, R_2 at approximately 100kohms.)
Each time constant of NAB characteristic

Tape speed		9.5 cm/sec	4.75 cm/sec
T1	C1, R1	3180 μ sec	1590 μ sec
T2	C1 (R1//R2)	90 μ sec	120 μ sec

Unit (resistance: Ω, capacitance: F)

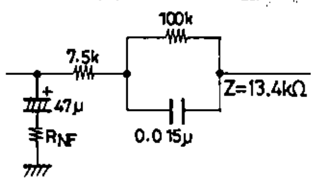
(2) Examples of NAB Constants

(a) Tape speed : 9.5cm/sec for an 8-track recorder (Z,AG:at f=1kHz)



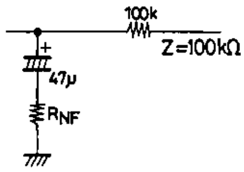
VG	30	35	40	dB
R_{NF}	180	100	56	ohm

(b) Tape speed : 4.75cm/sec for a cassette tape recorder



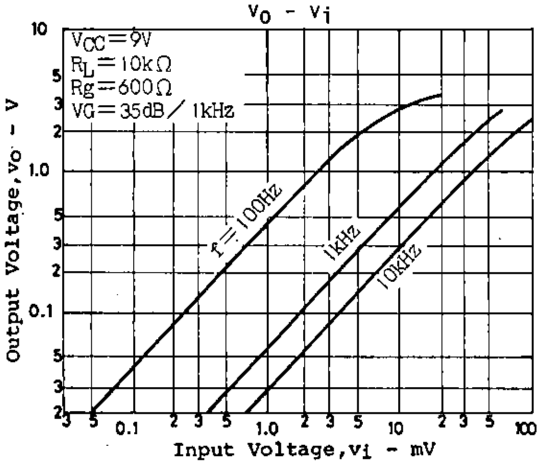
VG	30	35	40	dB
R_{NF}	440	240	130	ohm

(c) Flat amplifier

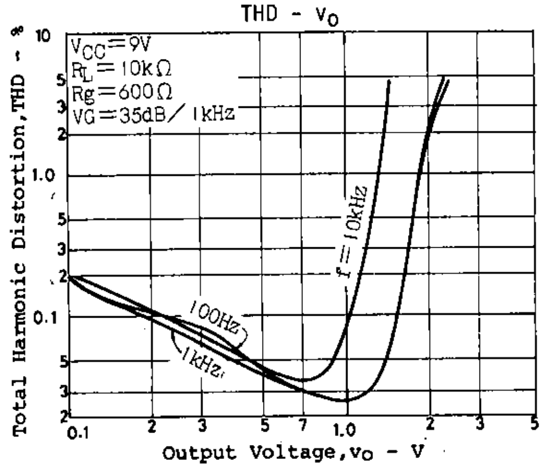


VG	30	35	40	dB
R_{NF}	3.2k	1.8k	1k	ohm

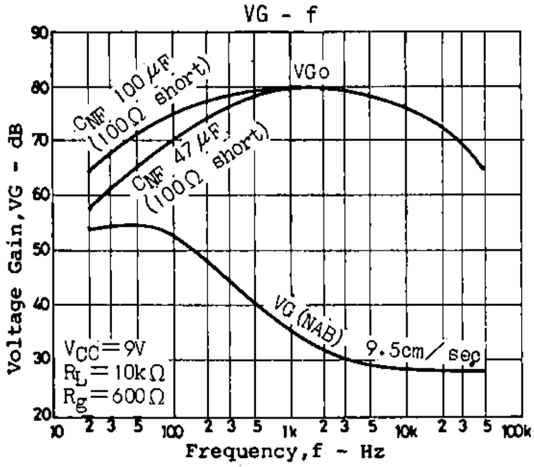
$V_O - V_i$



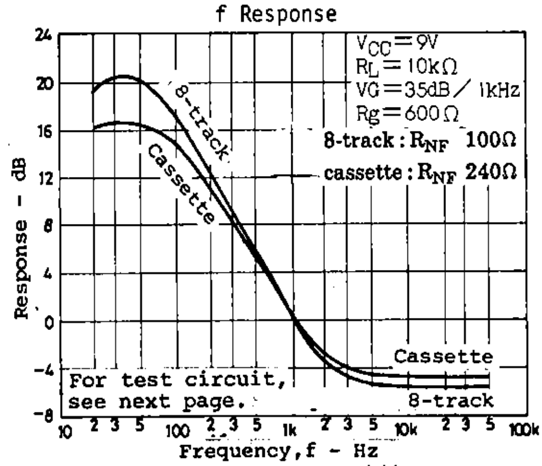
THD - V_O



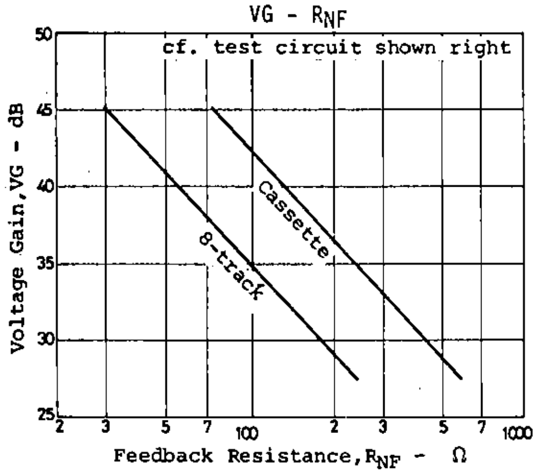
VG - f



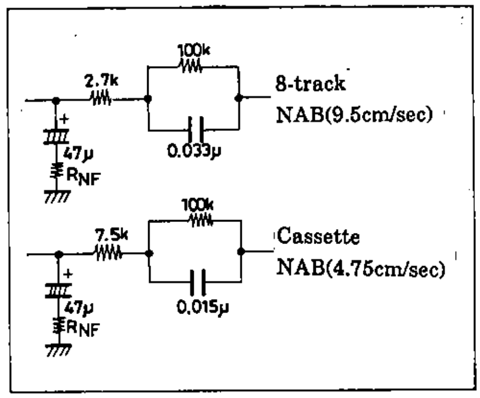
f Response



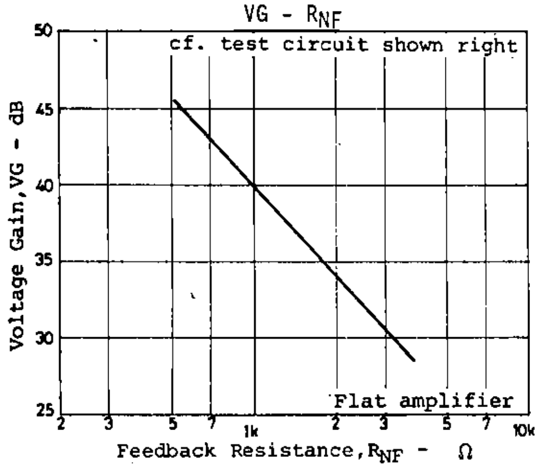
VG - R_{NF}



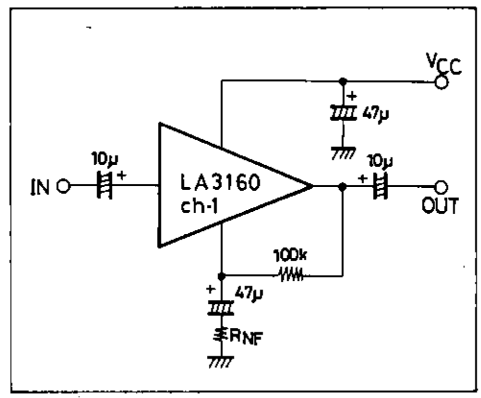
Test Circuit 1



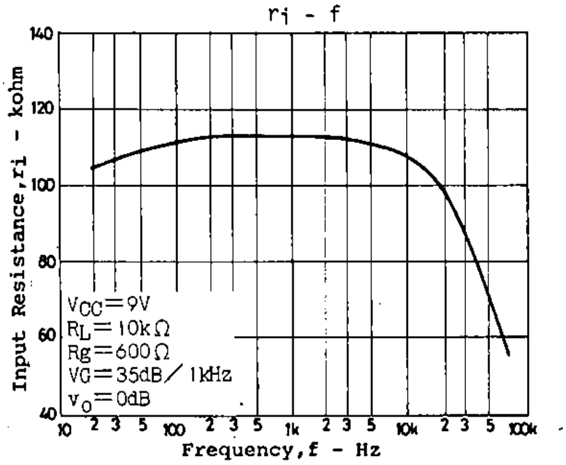
VG - R_{NF}



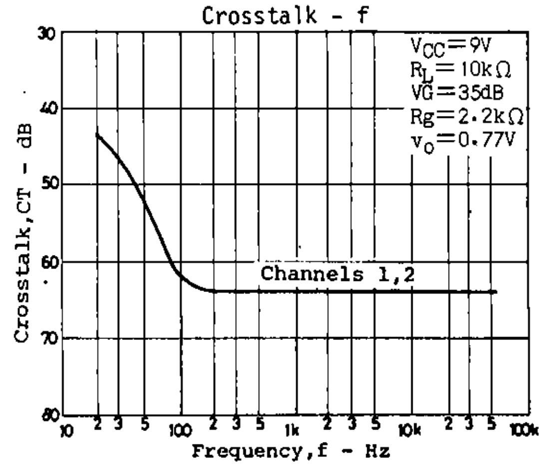
Test Circuit 2



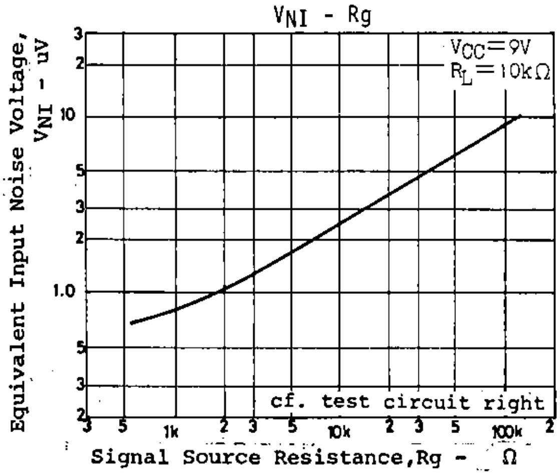
ri - f



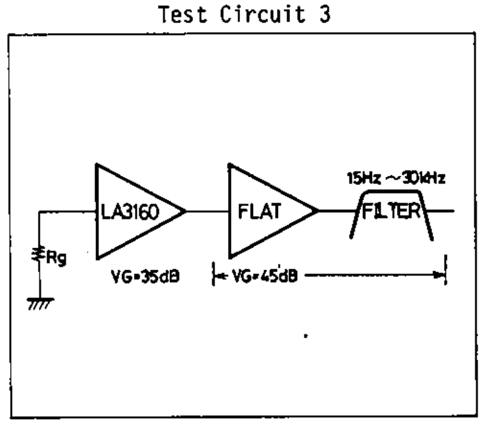
Crosstalk - f



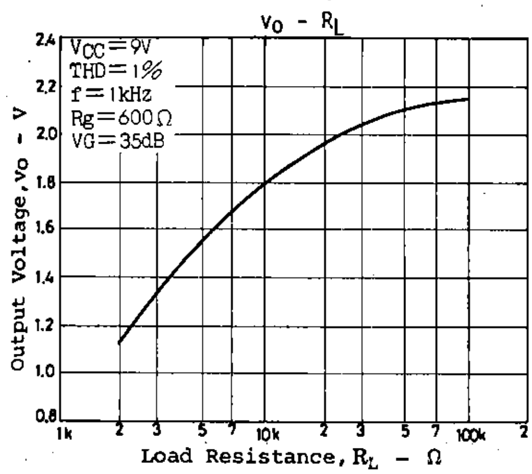
V_{NI} - Rg

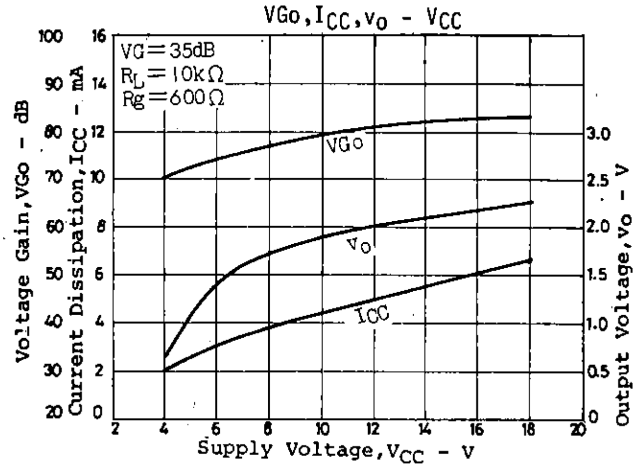


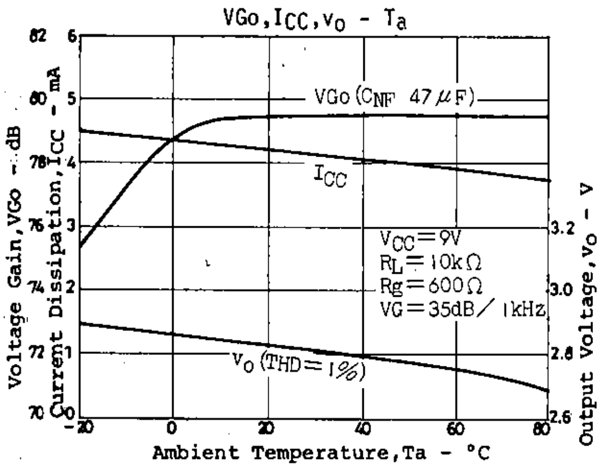
Test Circuit 3



Unit (resistance: Ω, capacitance: F)







Proper cares in using IC

1. Maximum Rating

   If the IC is used in the vicinity of the maximum rating, even a slight variation in conditions may cause the maximum rating to be exceeded, thereby leading to a breakdown. Allow an ample margin of variation for supply voltage, etc. and use the IC in the range where the maximum rating is not exceeded.

2. Short between pins

   If the supply voltage is applied when the space between pins is shorted, a breakdown or deterioration may occur. When installing the IC on the board or applying the supply voltage, make sure that the space between pins is not shorted with solder, etc.

3. Breakdown of IC attributable to inverted insertion

   If the IC is inserted inversely and operated, the IC may suffer from something unusual, thereby leading to a breakdown or deterioration of the IC. When installing the IC on the board or operating the IC, check the marked surface of IC.

Proper cares to be taken for obtaining optimum operation of IC

- Set DC resistance of R_1, R_2 of NAB element at approximately 100kohms.
- Determine the gain by changing R_{NF} without changing NAB constant. (Refer to Examples of NAB constant.)
- Supply voltage characteristics are sufficiently considered, but supply voltage is recommended to be between 5V to 18V.